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COURSE CODE:

COURSE TITLE: FLUID MECHANICS

1) Relative density = 0.8

$$d_1 = 150\text{mm} = 0.15\text{m}$$

$$d_2 = 75\text{mm} = 0.075\text{m}$$

$$Z_2 - Z_1 = 150\text{mm} = 0.15\text{m}$$

$$Q = 40 \text{ litres/second} = 0.04 \text{ m}^3/\text{s}$$

$$cd = 0.96$$

Pressure difference  $P_1 - P_2$

$$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.01767 \text{ m}^2$$

$$A_2 = \frac{\pi d_2^2}{4} = \frac{\pi \times 0.075^2}{4} = 0.00442 \text{ m}^2$$

$$Q = \frac{cd \times A_1 A_2 \times \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$$

$$0.04 = \frac{0.96 \times 0.01767 \times 0.00442 \times \sqrt{2 \times 9.81 \times h}}{\sqrt{0.01767^2 - 0.00442^2}}$$

$$0.04 = 0.96 \times 0.004656 \times 4.429 \sqrt{h}$$
$$4.429 \sqrt{h} = \frac{0.04}{0.96 \times 0.004656}$$

$$h = \left( \frac{0.04}{0.96 \times 0.004656} \right)^2 \div 4.429$$
$$h = 4.247 \text{ m}$$

$$h = \left( \frac{P_1}{\rho} + Z_1 \right) - \left( \frac{P_2}{\rho} + Z_2 \right)$$

$$h = \frac{P_1}{\rho} - \frac{P_2}{\rho} + Z_1 - Z_2$$

$$4.247 = \left( \frac{P_1 - P_2}{\rho g} \right) - 0.15$$

$$\frac{P_1 - P_2}{\rho g} = 4.247 + 0.15$$

$$P_1 - P_2 = (4.397) \rho g$$

$$P_1 - P_2 = (4.397) \times 0.8 \times 1000 \times 9.81$$

$$P_1 - P_2 = 34.5 \text{ kN/m}^2$$

$$2) \quad d_1 = 300 \text{ mm} \\ = 0.3 \text{ m}$$

$$d_2 = 150 \text{ mm} \\ = 0.15 \text{ m}$$

$$S_g \text{ of oil} = 0.9$$

$$S_g \text{ of m} = 13.6$$

Reading of different manometer

$$y = 250 \text{ mm} = 0.25 \text{ m}$$

$$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi \times (0.3)^2}{4} = 0.0707 \text{ m}^2$$

$$A_2 = \frac{\pi d_2^2}{4} = \frac{\pi \times (0.15)^2}{4} = 0.0177 \text{ m}^2$$

$$h = \left( \frac{P_1}{\rho g} + z_1 \right) - \left( \frac{P_2}{\rho g} + z_2 \right)$$

$$= y \left( \frac{S_{oil}}{S_{m}} - 1 \right) = 0.25 \left[ \frac{13.6}{0.9} - 1 \right]$$

$$h = 3.53 \text{ m}$$

i) Discharge of oil,  $Q$

$$Q = \frac{A_1 A_2 \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}} \times cd$$

$$Q = \frac{0.0707 \times 0.0177 \times \sqrt{2 \times 9.81 \times 3.53}}{\sqrt{(0.0707)^2 - (0.0177)^2}} \times 0.98$$

$$Q = 0.1489 \text{ m}^3/\text{s}$$

$$ii) \quad P_1 - P_2 = ? \quad S_g = 13.6 \quad cd = 0.98 \quad z_2 - z_1 = 300 \text{ mm} = 0.3 \text{ m}$$

$$\left( \frac{P_1}{\rho g} - \frac{P_2}{\rho g} \right) + (z_1 - z_2) = h$$

$$\frac{P_1 - P_2}{\rho g} - 0.3 = 3.53$$

$$\left( \frac{P_1}{\rho g} + z_1 \right) = \left( \frac{P_2}{\rho g} + z_2 \right)$$

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$$\frac{P_1 - P_2}{\omega} \approx 3.83$$

$$\begin{aligned} P_1 - P_2 &\approx 3.83 \times 0.9 \times 9.81 \\ &= 33.81 \text{ kN/m}^2 \end{aligned}$$